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GEOGRAPHICAL RECORD

NORTH AMERICA

Arable Land in the United States. A recent paper on ''Arable Land in the United States,'' by O. E. Baker and H. M. Strong (*Yearbook Dept. of Agric. for 1918*), describes in outline the location and extent of present arable, non-arable, and potentially arable land in this country. Most of the present arable land lies east of the 100th meridian, and this produces four-fifths of the corn, three-fourths of the wheat and oats, and three-fifths of the hay crop of the nation. In order that land may be adapted to the production of crops, several conditions must be met. First, it must not be so stony or hilly as to prevent the use of the plow and of other farm machinery. Nearly one-fifth of the land area of the United States is too hilly or too rough for successful crop production. A second condition is that the rainfall must be sufficient. Where the mean annual rainfall in Montana is less than 12-15 inches, or less than 18 inches in eastern Colorado, 20 inches in the Texas Panhandle, and 25 inches in the lower Rio Grande Valley of Texas, the production of crops without irrigation is a precarious undertaking. The minimum rainfall needed for successful crop production varies from 9 to 30 inches in different parts of the United States, the amount depending on the local conditions of soil and climate. As a general rule, the rainfall requirement increases from north to south with increasing evaporation (under higher temperatures) and with the occurrence of a less favorable seasonal distribution of precipitation. It is estimated that nearly one-third of the land area of the United States receives too little rainfall for profitable crop production at normal prices and has no possibility of irrigation. Occasional years of heavier rainfall than normal result in large profits, but in the long run it is better business policy to use such lands for grazing, raising only a few acres of crops for supplementary feed in swales and seepage basins.

A third condition, also climatic, relates to the length of the growing season. The amount of heat must be sufficient, and the season between the first and last killing frosts must be long enough to mature the crops. Lastly, there are considerable areas where the soil is too sandy or infertile for profitable crop production at prevailing prices. These districts are better adapted to forests. Taken in all, more than one-half of the land area of the United States is unfitted for profitable crop production because of rough topography, deficient rainfall, low temperature, or infertile soil. With the exception of about 40,000,000 acres of desert, this land is used, to a greater or less extent, for the production of wood and timber and for grazing stock.

''Potentially arable land'' consists of forest, ''cut-over'' land, and woodland, including that in farms, covering more than one-tenth of the land area of the country; and also some 60,000,000 acres of swamps and other wet lands susceptible of drainage. A third expansion of the agricultural area is to be sought in the potentially irrigable land which is awaiting development in the West. This is estimated at 30,000,000 acres, if all available sources of water supply were fully utilized, and would double the present area of irrigated land. It is to be noted, however, that the cost of construction of dams and of canals and ditches becomes greater and greater as less and less favorable projects are developed. Even now the supply of land under the ditch and ready for farming in several Federal reclamation projects exceeds the demand at the price quoted. There are, further, about 50,000,000 acres of ''unimproved land other than woodland'' in the rainier Eastern States, consisting of unused fields, stony upland pastures, ''abandoned farms,'' and waste land. Of this, probably not more than two-thirds will ever be put into crops. Lastly, a further development of dry farming may provide for a few more farmers in the West.

Certain economic considerations have to be taken into account in this matter. The country will require a woodland area of at least 450,000,000 acres to supply a population of 150,000,000 people. Hence, a good deal of potentially arable land will remain in forest. Again, an appreciable portion of land suitable for crops will remain as pasture. It seems probable that the area in crops will never reach the estimated possible total of 850,000,000 acres. The increasing cost of reclamation will lead to a more intensive cultivation of the more fertile or favorably situated land, and to the use of the lower grades of arable land for grazing or timber production. The well-cultivated lowlands and the ''abandoned farms'' in the highlands of the northeastern states illustrate this tendency.

R. DEC. WARD

American Meteorology and the War. Among the scientific contributions made by the United States towards winning the war, the meteorological work carried on by the Weather Bureau, the Army, and the Navy was of peculiar importance. It is well that, as a chapter in the scientific history of the war, there should be available some authoritative account of the various phases of this work. The *Monthly Weather Review* for April, 1919, contains a series of papers which furnish much general and interesting information on this subject. The most important results accomplished in connection with the ''Aerological Investigations of the Weather Bureau During the War,'' which are discussed by Willis R. Gregg, were (1) the aid given the Army and the Navy in organizing and equipping their meteorological services, and (2) the information and advice furnished both military and naval services regarding free-air conditions. Lieutenant Colonel R. A. Millikan (Signal Corps, U. S. A.), who begins his paper on ''Some Scientific Aspects of the Meteorological Work of the United States Army'' with the statement that ''prior to 1914 a meteorological section was not considered a necessary part of the military service,'' enumerates four distinct divisions of his problem as follows: the extension of our knowledge of the law of motion of pilot balloons; the procurement of data and the development of methods for the preparation of artillery range tables; the development of long-range propaganda balloons; the charting of the upper air in the United States and overseas, in aid of aviation.

Captain B. J. Sherry and Lieutenant A. T. Waterman describe the work of ''The Military Meteorological Service in the United States During the War.'' The problem was ''the project of creating what was in many respects an entirely new service for the Army designed to supply the military organization with complete and up-to-date meteorological information, and this as promptly and efficiently as possible.'' ''The Work of the Aerographic Section of the Navy'' is briefly described by Lieutenant Commander Alexander McAdie, U. S. N. R. F., Senior Aerographic Officer, and emphasizes the extraordinarily rapid development of this branch of meteorological activity, which was not organized until January, 1918. Commander C. T. Jewell, U. S. N., retired, gives an account of the ''Work of the Naval Observatory in Connection With Naval Aerography,'' and R. H. Finch, U. S. N. R. F., describes ''Meteorology in the Naval Aviation Service Overseas.'' Other papers are devoted to descriptions of the special forms of instruments or of graphic devices which were used or devised in connection with war meteorology.

The whole series of articles gives an interesting account of the meteorological activities of the United States Government during the war. It is a record of good work, well done, of which the country may be proud. R. DEC. WARD

The Roosevelt Wild Life Forest Experiment Station. Until the recent establishment of the Roosevelt Wild Life Forest Experiment Station at Syracuse, N. Y., there had never been before in America and probably not in the world a station devoted primarily to the study of forest wild life. This first station of its kind is described by Dr. Charles C. Adams, its director, in *Science* for June 6, 1919. The station is a memorial to the late Colonel Theodore Roosevelt in recognition of his interest in and work for forestry and wild forest life. New York State is a particularly appropriate place for such a station not only because it was his home state but because of the large extent of forest land and fresh-water surface, which nearly equals in acreage the extent of tilled land and thus leads to economic and social problems of high rank. The duties of the station are described as follows: ''to make investigations, experiments, and research in relation to the habits, life histories, methods of propagation and management of fish, birds, game, and food and fur-bearing animals, and forest wild life.'' In addition to its conservation features the plan provides for the training of students who wish to specialize in this kind of ecologic work, either as technical forest investigators or as practical foresters interested in the management of fish and game. It is expected that the memorial will receive support from the Legislature of New York as well as from private citizens who wish to honor the memory of Roosevelt.

AFRICA

The French Penetration of Morocco. In 1912, when Morocco came under French protection, the country was being desolated with strife and lawlessness. Already France had been compelled to intervene on the Atlantic seaboard at Casablanca and in the east that marches with Algeria. Real pacification began at the end of April, 1912, with General Lyautey in charge of the formidable task. Two years later the European War broke out, and to those unacquainted with the genius of the Resident General the prospect looked dark indeed—pacification so recently begun and still far from complete; turbulent tribes stirred beyond their wont by ceaseless German intrigue; the government's forces depleted—what hope was there for Morocco? General Lyautey solved the problem by maintaining all the frontier posts and advanced marches intact, by redoubling the initiative of the remaining mobile forces on the untamed front. Since 1914 the area of occupation has been extended and the pacified tribes have remained loyal, nay more, they have offered their services to the cause of France (Augustin Bernard: La France au Maroc, *Ann. de Géogr.*, January, 1917. The map of penetration, reproduced herewith, should be compared with the orographical, rainfall, vegetation, and population maps accompanying Alan Ogilvie: Morocco and Its Future, *Geogr. Journ.*, Vol. 39, 1912, and A. Bernard: Le Maroc, Paris, 1913.)

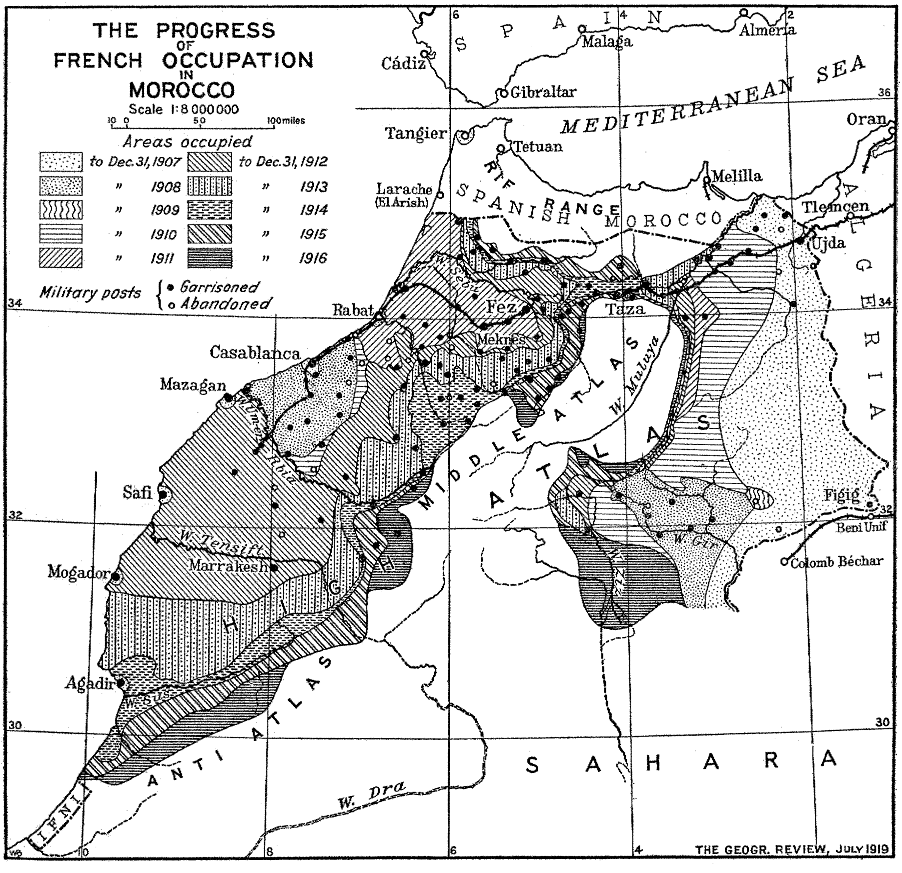

FIG. 1—(Based on a map accompanying the paper cited in the text.)

The progress and policy of French penetration in Morocco can only be understood if the geography of the country be appreciated. Early occupation took place in the most accessible regions, the eastern plain and plateaus that continue the Algerian steppes, the fertile black-earth plains, and the plateaus bordering the Atlantic, the only region accustomed to submission, the only part of the Sherifian Empire really controlled by the Sultan. Separating the eastern and western areas are the chains of the High and Middle Atlas and the Rif of Spanish Morocco. The mountains dominate the plains, and the mountain people, whose order of life is so different from that of the plains, dominate the plainsmen, for they are the perpetual disturbers of the peace. Occupation of the plains alone affords no security; to be master anywhere the central authority must be master everywhere. The least known, the most inaccessible part of the mountain region, is the Middle Atlas, the Gordian knot of French occupation as it is the orographic knot of the country. In the extreme south and, more important, to the north, in Spanish Morocco, are two other insurrectionary centers by which the connecting link of Middle

Atlas Berbers receive German arms and ammunition. In particular, annoyance is still caused by the notorious Raisuli, a brigand who has raised himself to the status of an independent chief. Between the Rif and the Middle Atlas, however, there exists the *couloir* of Taza, the narrow passageway that before the formation of the Straits of Gibraltar was the outlet for the Mediterranean. The Taza *couloir* is a historic route between Algeria and Morocco. Romans, Vandals, and Arabs have passed along it; possession of it is vital to any power claiming authority over northwestern Africa. Hence, despite the dangers while the heights are in enemy hands, it has been occupied; and one of the main objectives of present penetration is the widening of the gap southward; on the north of course nothing can be done. Occupation will shortly be sealed by completion of the railroad. Today (see: La Foire de Rabat, *L'Afrique Française,* Sept.-Nov., 1917) there remains only a short link to connect Taza and Fez and thus unite Algeria with the Atlantic coast. The frontier force is likewise particularly concerned with isolating the two main Berber groups of the Middle Atlas, the Beni-Waraïn with the Riata and the Zaïan. Between them lies a weak spot in the rampart of the Middle Atlas, a gently sloping plateau giving access to the heart of the mountains. It is occupied by the nomadic Beni-Mgild and Beni-Mtir, people who, because of their nomadism, are more approachable than the neighboring Berber tribes, tied to the cultivation of their isolated mountain valleys. South of the Atlas is projected the opening of routes in the Sahara whereby a system of policing may be established in connection with the existing organization of the *méharistes* of Mauritania and southern Algeria, the ''Northwest Mounted Police'' of the Sahara.

Details of the latest movements in Morocco are published in the number of *L'Afrique Française* for January-February, 1919 (pp. 23-28). The extent of German intrigue is very evident: the situation was always in close sympathy with that in Europe. Insurgent endeavors were specially great during April, May, June, July, 1918. News of the armistice was not credited, and there were further outbreaks in December and January, but these appear to have been ''the last wave.''

AUSTRALASIA AND OCEANIA

Hawaiian Forest Reserves. Following the policy established by the United States on the continent, the Hawaiian territorial government has set apart certain well-timbered areas as forest reserves. According to the December, 1918, issue of the *Hawaiian Forester and Agriculturist,* official organ of the Board of Agriculture and Forestry, the designation of five new districts on December 31 completed the area to be so segregated. The latest additions increase the forest reserves by 41,355 acres, bringing the total so set apart in the different islands up to 554,842 acres. Added to this there are some 260,000 acres, which, though still privately owned, it is expected to have protected and administered in a similar way.

To science the Hawaiian forests are of peculiar interest because of their distinctly endemic character. (See an article by Vaughan MacCaughey in the *Plant World,* Vol. 19, 1916, pp. 162-166.) Commercially the only timber of importance is that from the *ohia* and the *koa* trees, the former, a dark, hard, close-grained wood, being used for flooring, railroad ties, and paving blocks, while the latter, the so-called ''Hawaiian mahogany,'' is much prized for its beautiful golden-red wood, suitable for fine cabinet work and for interior furnishings.

The greatest value of the forests, however, is as a protection to the watersheds of the islands. The windward slopes throughout the archipelago receive from 400 to 500 inches of precipitation a year. With the forest cover removed, this heavy rainfall would soon occasion destructive floods and excessive erosion. On the other hand the westward, or leeward, side of the islands is in most cases decidedly arid and can be cultivated only by means of irrigation.

Owing to the porous character of the volcanic soil much of the water now sinks deep into the ground but has been successfully reached by artesian wells. On some plantations the abundant water power of the rainy slopes is utilized to generate electricity, which, wired to the desert districts on the other side of the island, pumps water from wells to irrigate the fields. In 1917, according to the publication cited above (May, 1918) 62 per cent of the sugar, the principal product of the islands, was grown on irrigated land. It would seem evident, therefore, that the continued prosperity of the inhabitants depends in very large measure upon the proper control of the stream flow and the protection of the areas which supply the artesian basins, both of which can be accomplished only by the conservation of the forested districts on the higher lands.

The chief destructive agents are fires, wasteful cutting of timber, and the wild cattle that abound in some of the mountainous districts. Against these the forestry service can contend successfully only when the regions concerned are placed under government administration.

As in other such reserves an attempt is being made to render the districts segregated of further value to the people, by opening some of them for camping sites and by preserving the natural beauties for which the islands have long been famous.

ECONOMIC GEOGRAPHY

Sea Bamboo As a Source of Potash. Among the problems of the war was the manufacture of chemicals formerly derived from Germany or from sources outside of Germany where production was affected by abnormal conditions of trade. Mr. G. F. Britten in the *South African Journal of Science* for October, 1917, published a valuable account of his experience with seaweed as a source of potash in South Africa. There is a variety of seaweed which grows in great abundance near the shores of the Cape peninsula and is known as sea bamboo. The use of seaweed as a fertilizer has been known, of course, for many years. In the Channel Islands seaweed was collected and allowed to dry near the shore and then burned on the household hearths and the ash sold to farmers, who used it on their wheat fields. Seaweed is also used along the New England coast, in California, and many other localities.

Mr. Britten selected for his analyses freshly stranded specimens of sea bamboo. He found that from the trunk portion of the seaweed he could derive an ash containing not less than 33 per cent of potash and from the leaves an ash which contained not less than 22 per cent, which on a pre-war basis would be worth $40 and $27 a ton respectively. He further discusses the direct use of the seaweed and points out that bordering the coast of South Africa are hundreds of different varieties, of which little or nothing is known except the composition, and urges action looking toward the building up of an industry that will yield important results in South African agriculture.

PHYSICAL GEOGRAPHY

Solar Radiation Observations and Weather Forecasting. A very interesting investigation, which may lead to results of unusual importance, is being carried on by the Smithsonian Institution and Mr. H. H. Clayton, Chief of the Division of Forecasts of the Argentine Meteorological Office. Since July 27, 1918, the Smithsonian Astrophysical Observatory has been conducting daily observations at Calama, Chile, of the solar constant of radiation. By means of special devices, and owing to the skill and zeal of the observers, Messrs. A. F. Moore and L. H. Abbot, the determination of the solar constant of radiation is completed on the same day that the observations are made. The result may, if desirable, be telegraphed within ten hours of the beginning of the observations. Mr. H. H. Clayton, at Buenos Aires, is in communication with the observers at Calama and is making studies of the relations of temperatures in Argentina to the values of the solar constant determined at Calama. Correlations as high as 68 per cent have been found between the two variables.

If temperatures at any station may eventually be predicted for some time in advance on the basis of measurements of the solar constant of radiation, a considerable number of solar radiation stations will be necessary in widely separated cloudless districts (C. G. Abbot: Work of the Smithsonian Astrophysical Observatory at Calama, Chile, *Monthly Weather Rev.*, Vol. 47, 1919, pp. 1-3). R. DeC. Ward

Increase of Precipitation on Mountains. Professor Alfred J. Henry, of the Weather Bureau, read a paper on "Increase of Precipitation With Altitude" before the Association of American Geographers at Baltimore, December 27, 1918, which has been printed in a recent number of the *Monthly Weather Review* (Vol. 47, 1919, pp. 33-41). Various factors control the relation between altitude and rainfall. When mountain systems are more or less parallel with the direction of the rain-bearing winds, there is little or no increase in precipitation. Other things being equal, the steeper the slope of the mountains, the greater the precipitation. The temperature and relative humidity of the air at the beginning of the ascent obviously determine to a large extent the quantity of rain or snow which falls, as does the duration of the rainy winds. The altitude of the zone of maximum rainfall seems to vary but little with latitude. It averages somewhat under 1,000 meters in the tropics and between about 1,400 and 1,500 meters in temperate latitudes. It is lowest in winter and highest in summer. R. DeC. Ward